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DATA REPORT

SPRAY DEPOSIT MAINE 1976
OPERATIONAL PROJECT FOR CONTROL OF THE EASTERN SPRUCE BUDWORM COMPARING EFFECTIVENESS OF SEVIN 4 OIL 3/4 AND 1 POUND PER ACRE[1]

September 1976

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
FOREST INSECT & DISEASE MANAGEMENT
METHODS APPLICATION GROUP
AND
NORTHEASTERN AREA

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INTRODUCTION

This data report presents the spray deposit data from that portion of the 1976 Maine Spruce Budworm Operational Control Project which compared 3/4 pound and 1 pound of Sevin 4-oil insecticide. Application of total formulation was made at the rate of 30 ounces per acre and 40 ounces per acre respectively, by C-54 two-engine aircraft. The spray release height was 150 feet above tree tops. The aircraft employed the Litton inertial guidance system to maintain parallel swath widths of 1200 feet.

Application of 3/4 pound or total formulation of 30 ounces per acre were made to spray blocks 2, 6, and 7 and 1 pound or total formulation of 40 ounces per acre were made to spray blocks 1, 3, and 8.

Four deposit cards were placed beneath the drip line of each sample tree. There were three sample trees for each of the 15 clusters. For the analysis, insect data and spray deposit data were averaged by cluster. Deposit cards were placed along roads transversing the spray blocks. These cards are referred to as open cards.

Insect mortality and tree defoliation data were provided by State of Maine Forest Service and spray deposit cards by the U.S. Forest Service for this analysis. The spray deposit cards were analysed by the Quantimet particle analyser at Los Alamos Scientific Laboratory. Deposit cards which were not suitable for automatic counting were hand counted by USFS FI&DM personnel at Methods Application Group, Davis, CA.

Data in this report includes the following:

a. Tables of mortality and defoliation means.

b. Summary table of spray recovery as a function of the application rate.

c. Summary table of spray recovery as a function of volume median diameter and drops per square centimeter.

d. Plot of spray deposit (drops per square centimeter and mass expressed in total ounces per acre) as a function of insect mortality and tree defoliation by spray block.

e. Plots of canopy penetration by spray block.

The volume median diameter (vmd) of the spray for the 30 oz/A blocks was 143 μm and for the 40 oz/A blocks the vmd also was 143 μm. These vmd's were determined from the analysis of all 1577 deposit cards on the project.

Spray drops recovered beneath the sample trees in the blocks ranged from 3 to 8 drops per cm^2 and in the open 8 to 20 drops per cm^2. There was no detectable difference in the per cent of spray recovered between the two application rates. Approximately 2 to 3 times more drops were observed in the open as compared to the trees. These data are summarized in Table 1.

Spray recovery by spray block as expressed in ounces per acre as a function of total material applied ranged from 5% to 15% beneath the sample trees and 14% to 45% in the open area. These data are summarized in Table 2.

The spray deposit data were plotted on Figures 1 thru 14 to portray the amount of spray mass which penetrated the canopy. The technique employed to determine the penetration was to plot the penetration ratio to each of 16 drop sizes. The penetration ratio is the total number of drops in each size category collected beneath the sample trees to the total number of drops in each size category collected in the open. For example, a penetration ratio of 1 is interrupted as total drops of a given size which penetrate the canopy and deposit on the ground. A ratio of 0.5 suggests that half of the drops of that size were deposited within the trees.

The plots show that the larger drops are scavenged by the tree while the smaller drops have a greater chance of finding their way to the ground.

A spray with a vmd of 143 μm as observed in this project appears to insure that all of the foliage is subjected to the spray.

Statistical tests on the insect populations are provided below:

Design:
- 9 randomized plots
- 3 treatments, Sevin (3/4 pound), Sevin (1 pound), checks
- each treatment repeated 3 times
- 15 clusters in each plot
- the primary sampling unit was the cluster, cluster means were computed by averaging insects per branch to the tree, and averaging the 3 tree means to get the cluster average.

The results are as follows:

Hypothesis: H_0: all blocks are equal, test statistic being F.

C_1: checks equal to Sevin 1 and Sevin 3/4

C_2: Sevin 1 pound equal to Sevin 3/4 pound

where C_1 and C_2 are orthogonal contrasts.

Both analysis of variance and analysis of covariance were used.

	Analysis of Variance			Analysis of Covariance		
	F	C_1	C_2	F	C_1	C_2
Pre Spray	19.24**	.58	5.51*	-	-	-
3 day	11.34**	-7.05**	1.36	12.41**	-7.50**	-.21
7 day	8.62**	-6.35**	.58	8.83**	-6.43**	-.06
14 day	16.51**	-9.77**	-.71	17.76**	-10.06**	-1.71
Defoliation	11.08**	-1.78	1.00	9.86**	-1.80	.76

** significant at 99 per cent level

* significant at 95 per cent level

The F values for all tests in both the analysis of variance and covariance are highly significant. The highest F value was on the prespray population levels indicating that the beginning point of all 9 blocks were not the same. The table of means clearly points this out - there was a range of 9.33 in check plot 9 to 43.28 in Sevin (1 pound) plot 1. Since the prespray F is highly significant, further interpretation of the regular AOV is questionnable. The purpose of the analysis of covariance is to adjust the 3, 7, and 14 day insect levels based on the prespray values.

The contrast C_1 comparing the difference between both Sevin 1 pound and Sevin 3/4 pound against the checks are highly significant for the insects at 3, 7, and 14 days.

The contrast C_2 comparing Sevin 1 pound against Sevin 3/4 pound is not significant for any tests.

SUMMARY OF RESULTS

1. There was a correlation between spray deposit and insect mortality.
2. There was no significant difference in insect mortality and defoliation between the two application rates.
3. Insect mortality in the check blocks was unusually high (76.5%); 50% of this mortality occurred between prespray and 3 day post spray.
4. The deposit cards in the open area of the 3/4 pound blocks received an average deposition of 9.47 ounces per acre and 12 drops per cm^2; the 1 pound blocks received an average deposition of 12.79 ounces per acre and 16 drops per cm^2. Decreasing the application rate by 25% from 1 pound per acre to 3/4 pound per acre also resulted in a 25% reduction in drops per cm^2 and mass recovered in the open.
5. The overall vmd of the spray recovered on both the 3/4 pound and the 1 pound per acre blocks was 143 μm.
6. Approximately 2 to 3 times more drops/cm^2 were observed in the open areas when compared to that deposited in the trees. Approximately 3 times more mass (ounces/acre) was recovered in the open areas when compared to mass recovered beneath the trees.
7. The smaller spray drops penetrated the forest canopy more consistently than the larger drops. More of the larger drops were observed in the open than beneath the sample trees.

Table 1 - Summary of volume median diameter (vmd) and drops per cm^2, Operational Project Maine.

BLOCK	APPLICATION RATE	VMD (μm)		DROPS PER CM^2	
		TREES	OPEN	TREES	OPEN
1	30 oz.	140	157	6	13
2	40 oz.	141	134	7	19
3	30 oz.	149	157	6	12
6	40 oz.	137	171	8	20
7	40 oz.	128	147	4	8
8	30 oz.	131	127	3	9

Table 2 - Summary of spray recovery data in ounces per acre and recovery as per cent of material applied, Operational Project Maine.

BLOCK	APPLICATION RATE	OUNCES PER ACRE		RECOVERY (%)	
		TREES	OPEN	TREES	OPEN
1	30 oz.	3.88	11.53	13	38
2	40 oz.	5.19	14.88	13	37
3	30 oz.	4.59	11.32	15	38
6	40 oz.	4.58	17.94	12	45
7	40 oz.	1.83	5.56	5	14
8	30 oz.	1.42	5.16	5	17

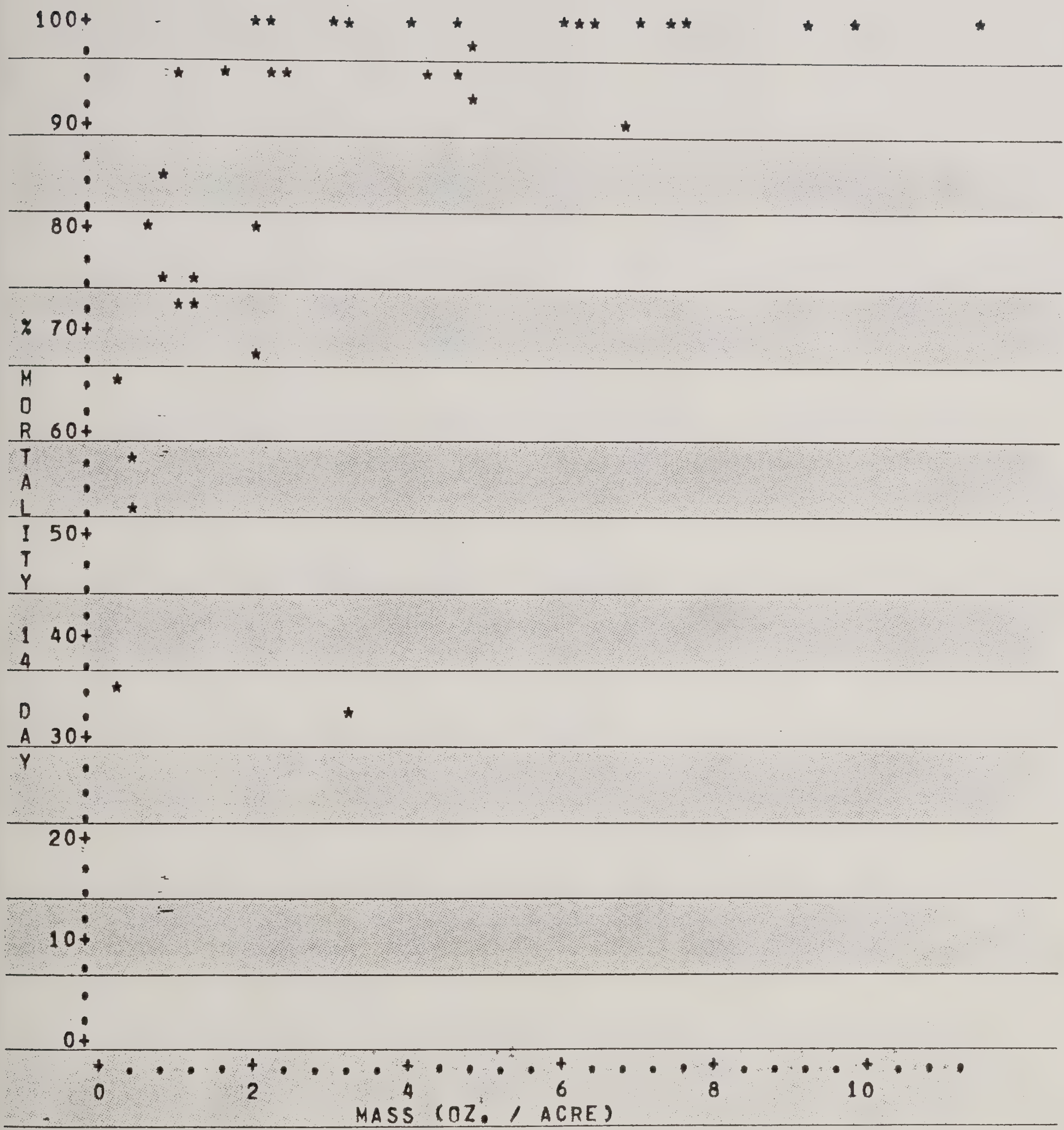


Figure . Graph of 30 oz/A, mortality data, 14 day level as a function of spray deposit in ounces per acre.

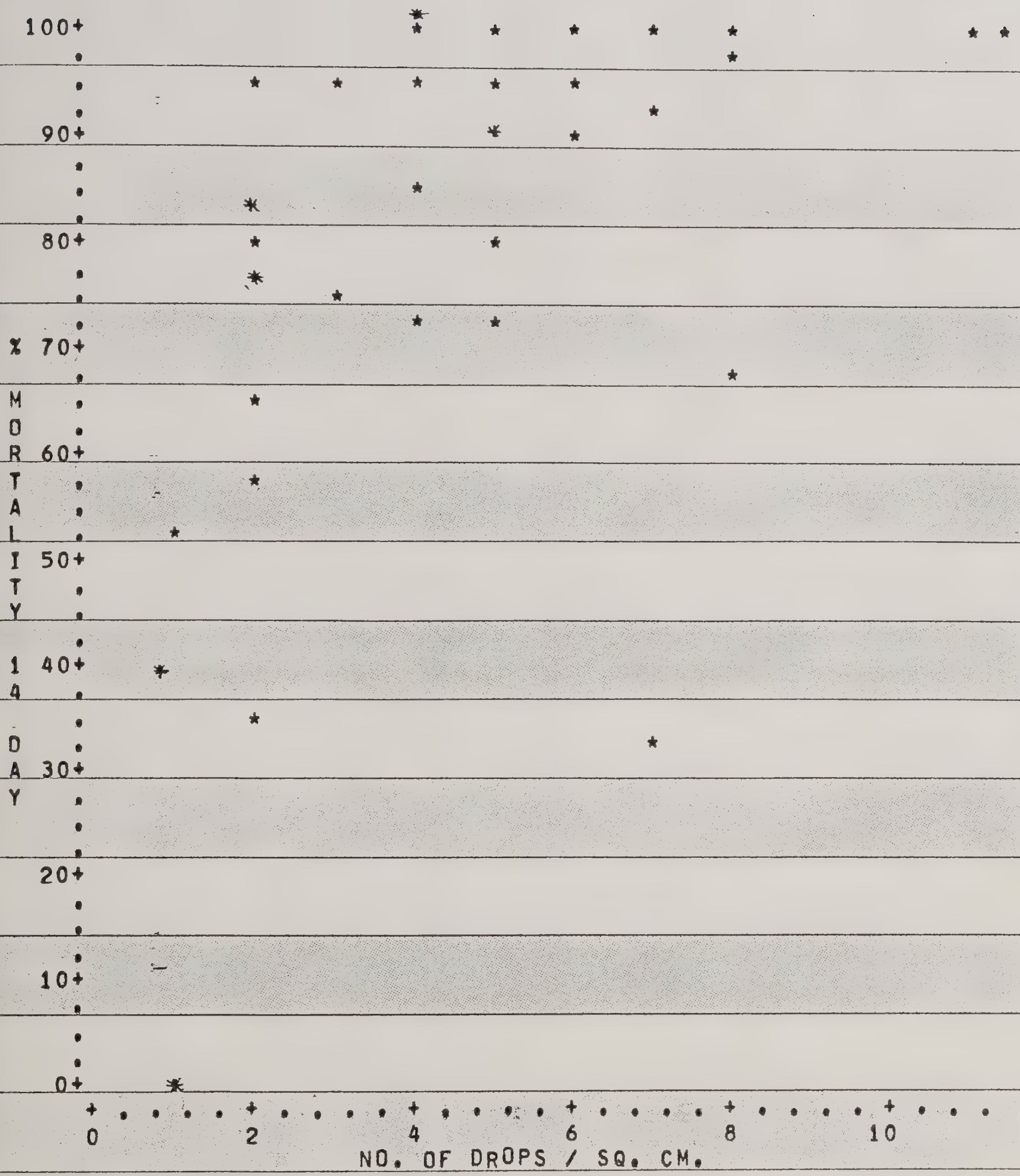


Figure . Graph of 30 oz/A, mortality data 14 day level as a function of spray deposit in number of drops per cm^2.

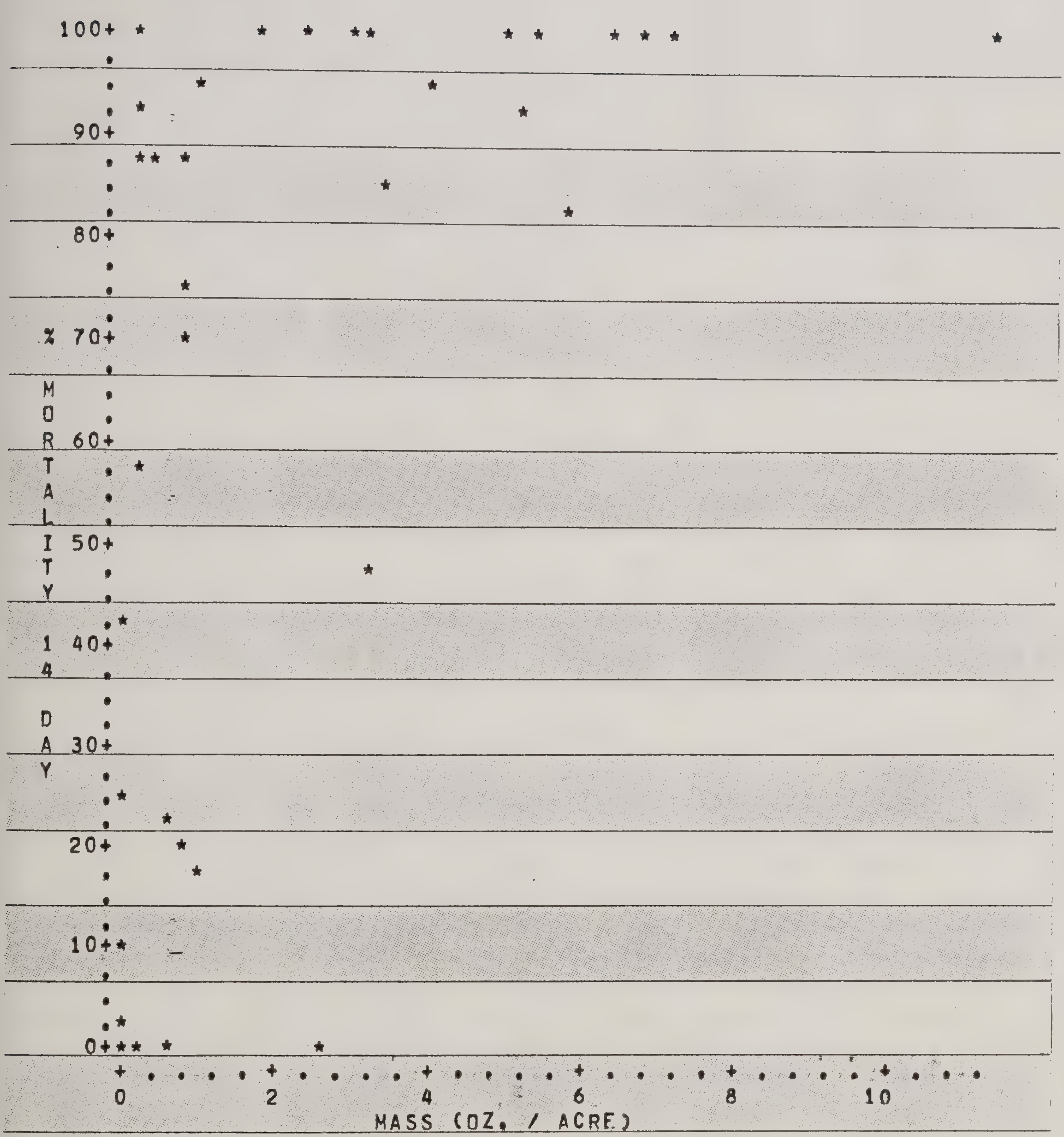


Figure . Graph of 40 oz/A, mortality data, 14 day level as a function of spray deposit in ounces per acre.

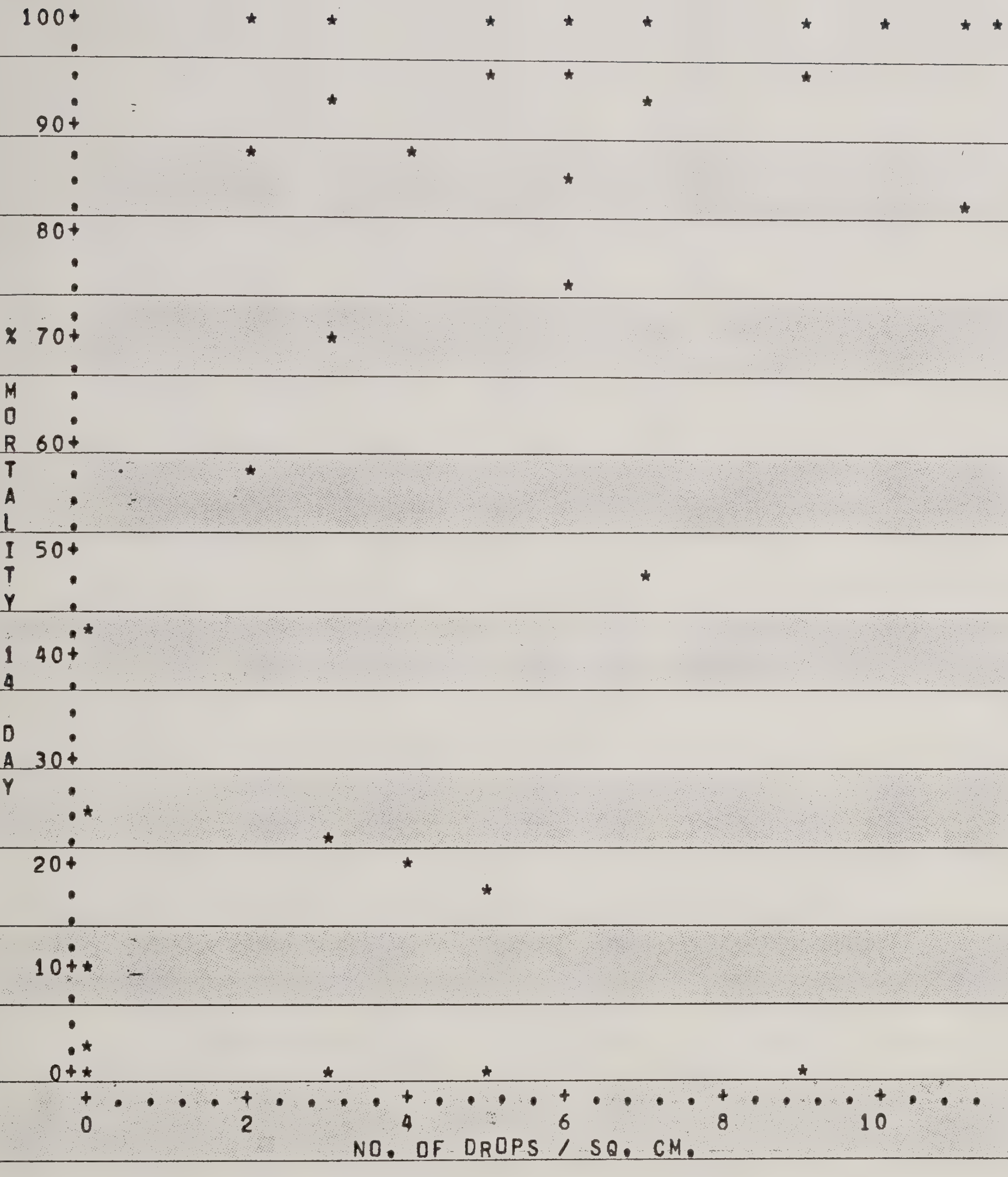


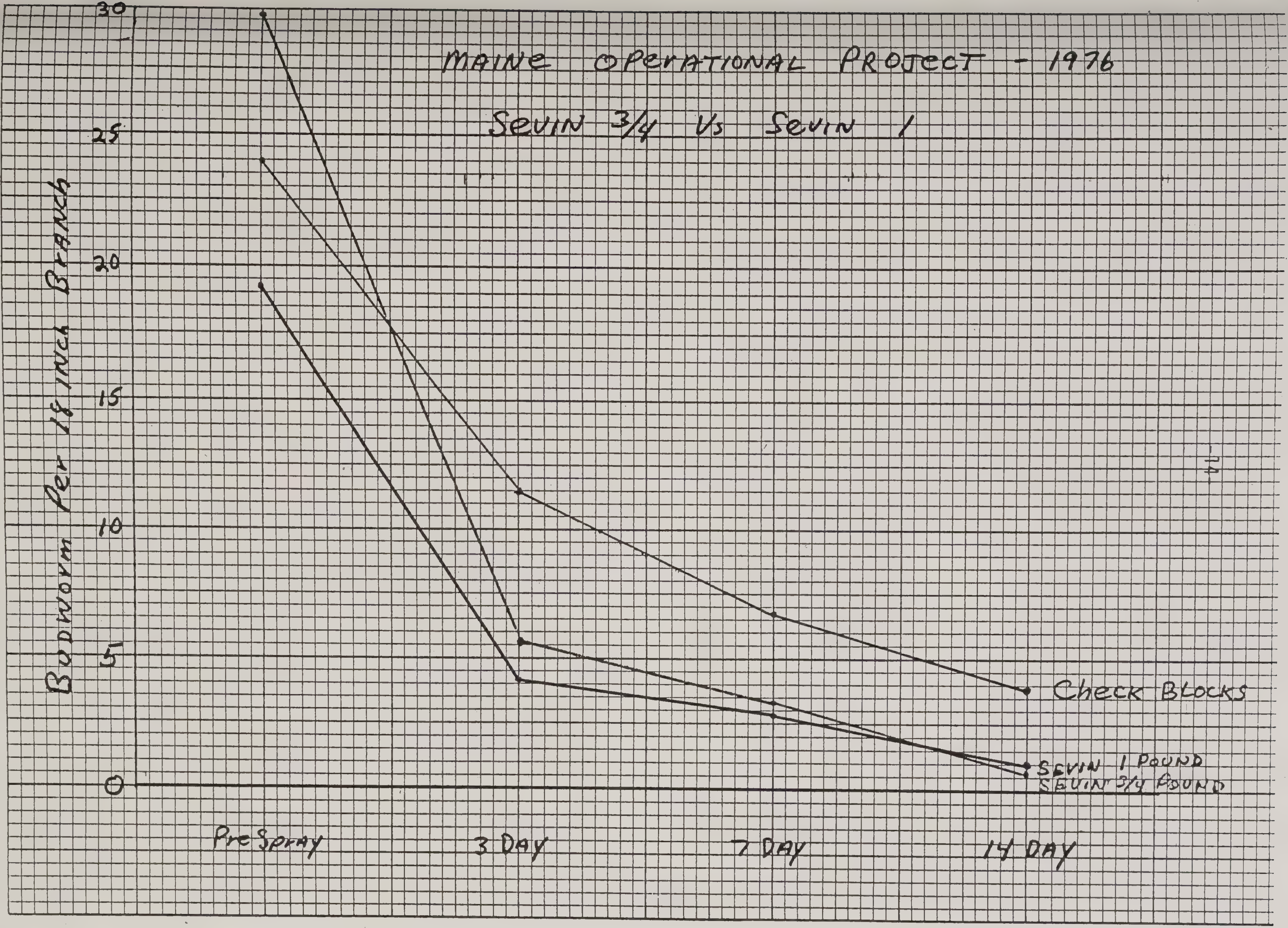
Figure . Graph of 40 oz/A, mortality data, 14 day level as a function of spray deposit in number of drops per cm^2.

MAINE OPERATIONAL PROJECT - SEVIN (1 pound) vs. SEVIN (3/4 pound)

PLOT		Population Levels Adjusted by Covariance				Adjusted Mortality		
		PRE	3 DAY	7 DAY	14 DAY	3 DAY	7 DAY	14 DAY
Sevin	2	25.89	1.65	.83	.07	.936	.968	.997
1 pound	6	19.92	8.40	4.28	1.83	.578	.785	.908
	7	11.79	4.62	3.79	1.85	.608	.679	.843
AVE		19.20	4.89	2.97	1.25	.707	.811	.916
Sevin	1	43.28	.07	1.36	.16	.998	.969	.996
3/4 pound	3	24.82	8.01	4.34	1.12	.677	.825	.955
	8	21.51	5.87	3.07	.45	.727	.857	.979
AVE		29.87	4.65	2.92	.58	.801	.884	.977
Check	4	33.26	10.25	5.29	2.26	.692	.841	.932
	5	28.09	14.66	9.49	5.62	.478	.662	.800
	9	9.33	9.39	5.67	4.08	-.006	.392	.563
AVE		23.56	11.43	6.82	3.99	.388	.632	.765

MAINE OPERATIONAL PROJECT - SEVIN (1 pound) vs. SEVIN (3/4 pound)

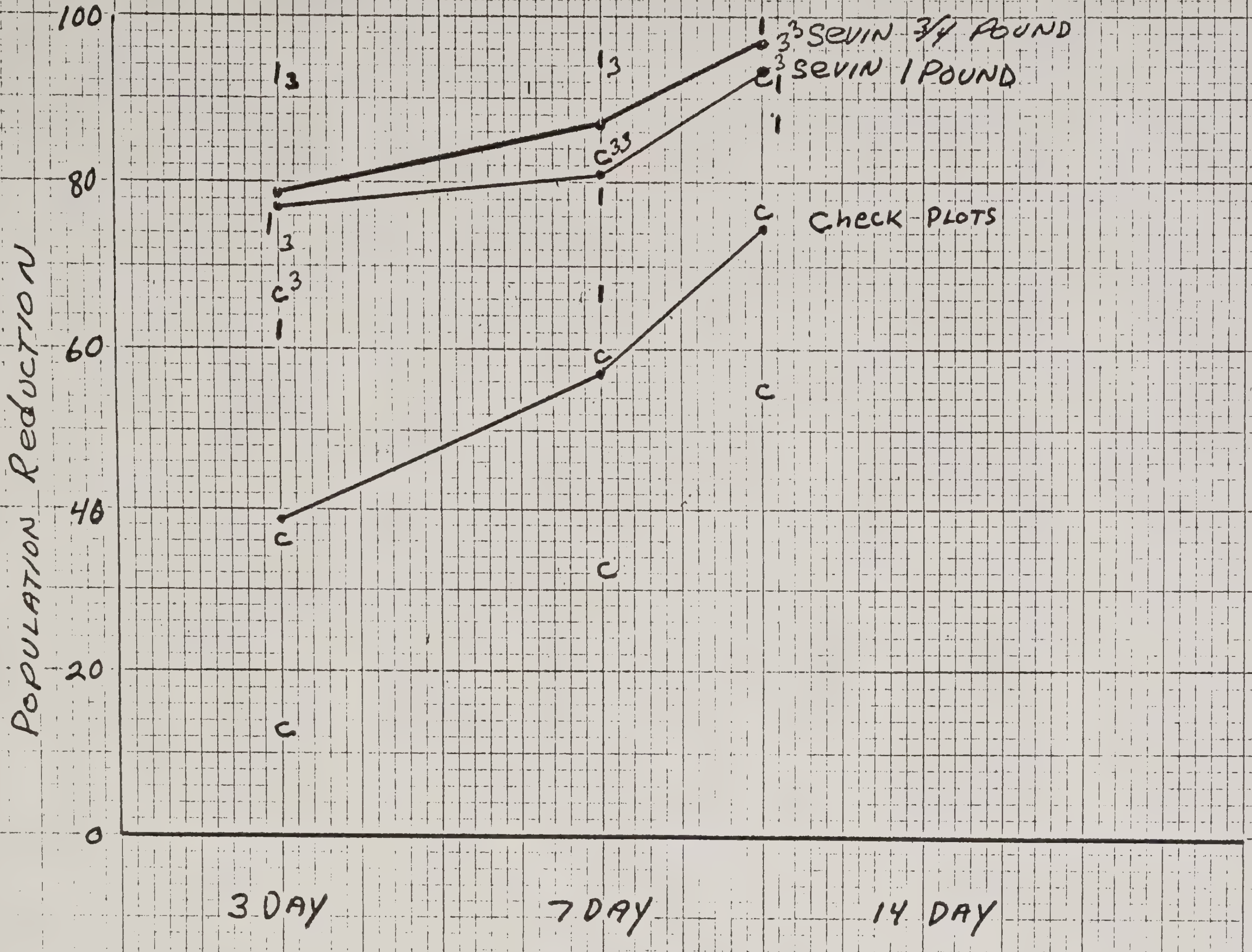
PLOT		Unadjusted Mortality			Abbotts Adjusted Mortality		
		3 DAY	7 DAY	14 DAY	3 DAY	7 DAY	14 DAY
Sevin	2	.926	.952	.996	-	-	-
1 pound	6	.609	.794	.920	-	-	-
	7	.770	.657	.877	-	-	-
AVE		.768	.801	.931	.557	.501	.675
Sevin	1	.917	.941	.977	-	-	-
3/4 pound	3	.682	.840	.962	-	-	-
	8	.730	.842	.982	-	-	-
AVE		.776	.874	.974	.614	.632	.841
Check	4	.662	.830	.926	-	-	-
	5	.371	.586	.752	-	-	-
	9	.132	.321	.548	-	-	-
AVE		.388	.579	.742	-	-	-



MAINE OPERATIONAL PROJECT - 1976

SEVIN 3/4 Vs SEVIN 1

MAINE OPERATIONAL PROJECT - 1976



8. Spray block 7 (1 pound per acre) and block 8 (3/4 pound per acre) received less than half of the application received by the other spray blocks.

9. The average spray recovery based upon mass in the 30 oz/A block was 31% of the application and in the 40 oz/A blocks it was 32%.

CONCLUSIONS

1. Spruce budworm mortality was significantly greater on the blocks sprayed with Sevin 4-oil than on the unsprayed blocks. This mortality was evident in samples taken at 3, 7, and 14 days after treatment; and was tested at the 95% level of confidence.

2. At the end of the larval feeding period, defoliation of sample trees was not significantly different (95% confidence level) between sprayed and unsprayed blocks. However, defoliation was slightly less (90% confidence level) in the blocks treated with 3/4 pound of Sevin 4-oil.

3. There was no significant difference in budworm mortality between blocks treated with 3/4 pound Sevin and 1 pound Sevin (95% level) at 3, 7, and 14 days after treatment.

4. There was no significant difference in defoliation between blocks treated with 3/4 pound Sevin and blocks treated with 1 pound Sevin (95% level).

5. Spruce budworm mortality in the check blocks was unusually high with 50% of this mortality occurring between the time of prespray and 3 day post spray sampling.

6. Reducing the application rate from 40 oz/A to 30 oz/A resulted in a corresponding reduction in spray deposit, both in mass and number of drops/cm^2.

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[illegible]

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[illegible]

[illegible] significantly [illegible] greater (95% confid[illegible]

[illegible]

[illegible]

no significant differences in [illegible]

[illegible] 95% level) at

after tree must.

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[illegible]

[illegible]

7. The reduced application had no effect on spray atomization. The vmd was 143 microns in both the 30 oz application and 40 oz application.

8. Spray deposit recovery ratios in open areas compared to forested areas were consistent both within and between blocks.

9. The data suggests that quality of application was slightly better in the 30 oz 3/4 pound Sevin blocks because 4 sample points were missed in the 40 oz 1 pound Sevin blocks.

10. Based upon canopy penetration graphs, smaller drops penetrated the forest canopy more readily than the larger drops. Although there was no deposit sampling within the tree, this observation suggests that all foliage was exposed to the spray.

11. There was a high budworm mortality in blocks 7 (1 pound Sevin) and 8 (3/4 pound Sevin) even though the spray deposit was 50% less than in the other blocks.

APPENDIX

1. Deposition Data
2. Canopy Penetration Plots

30 oz/A Blocks

Mortality and Defoliation
Graphs as a function of
Spray Deposition

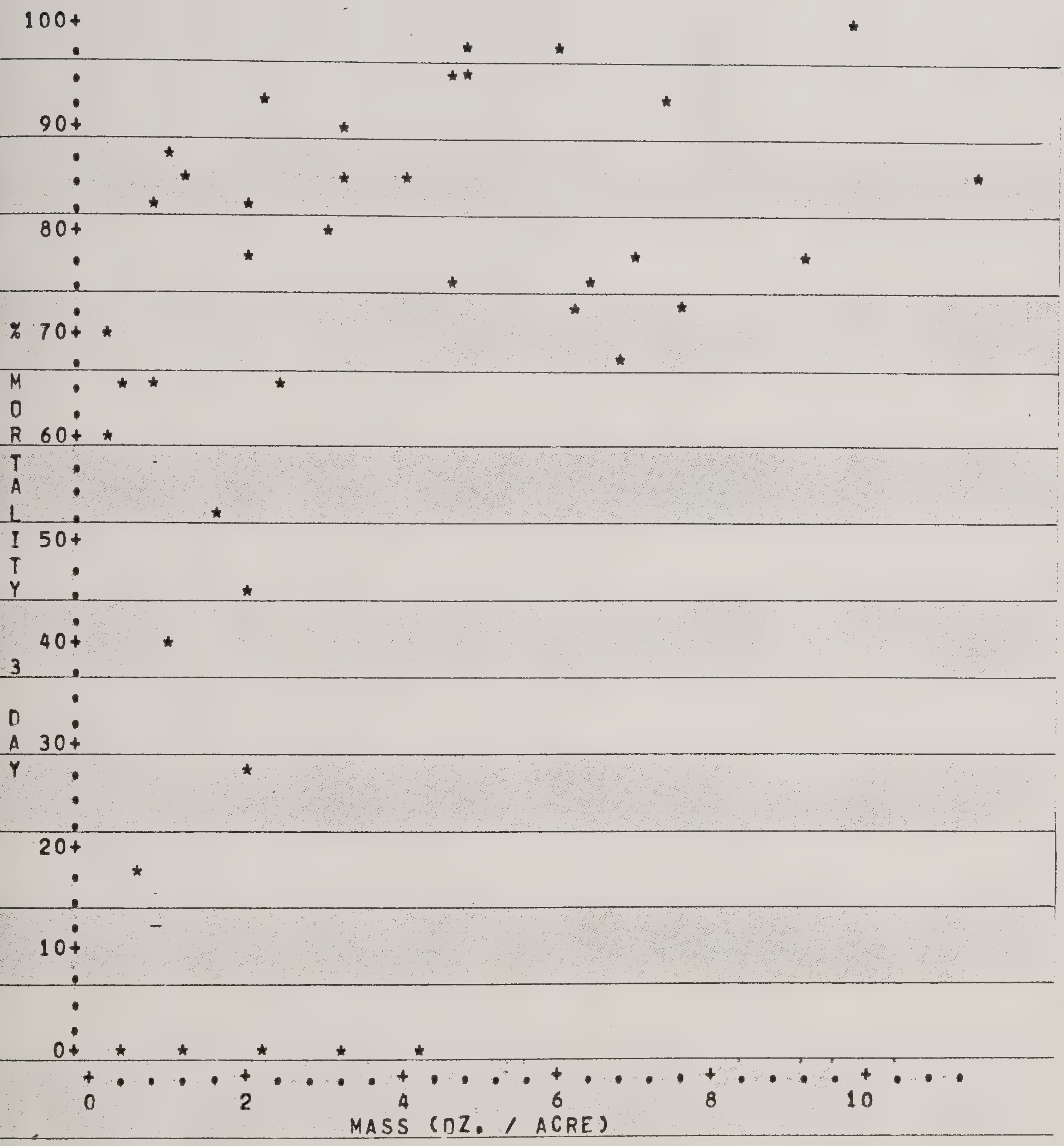


Figure . Graph of 30 oz/A, mortality data, 3 day level as a function of spray deposit in ounces per acre.

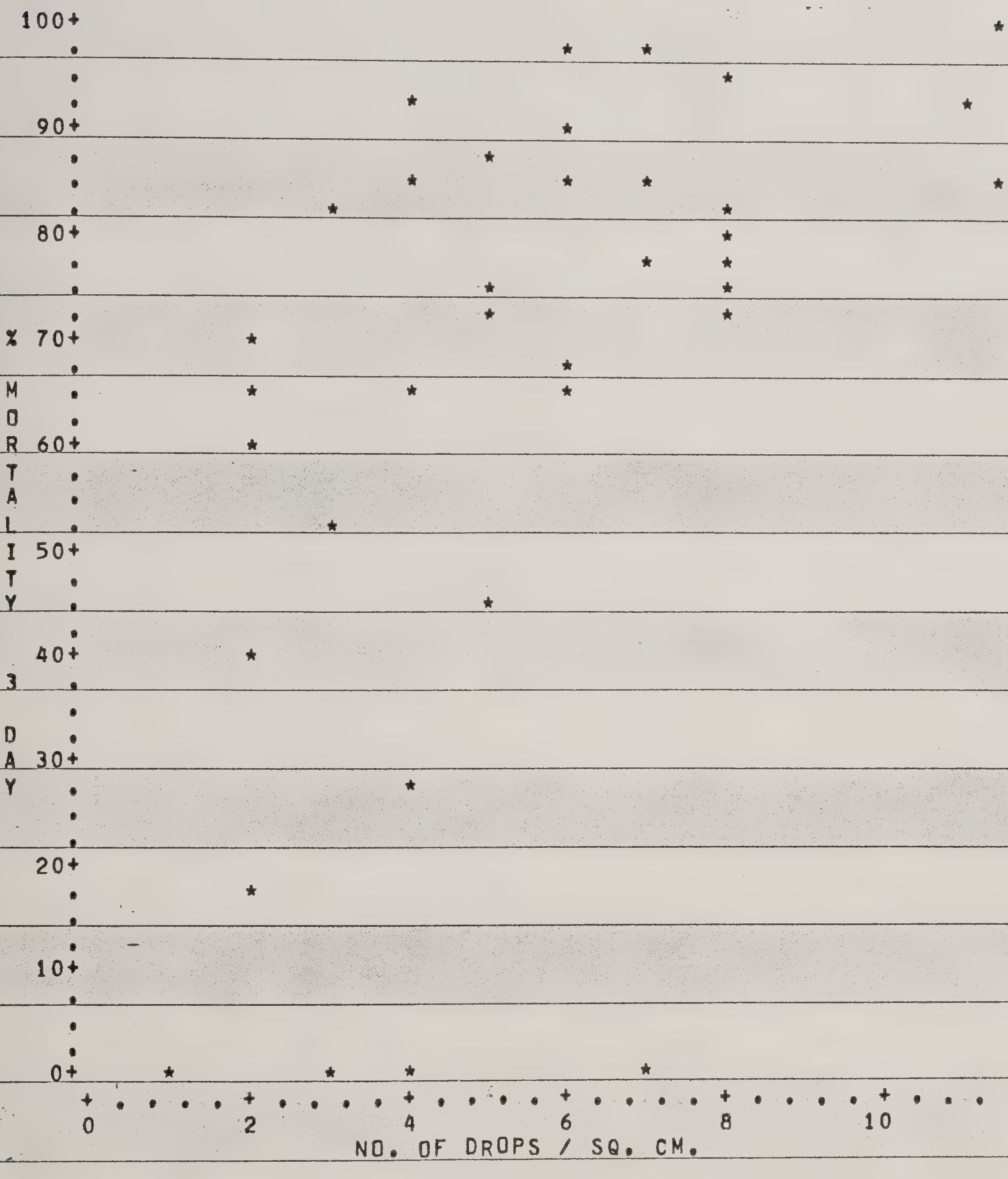


Figure . Graph of 30 oz/A, mortality data, 3 day level as a function of spray deposit in number of drops per cm^2.

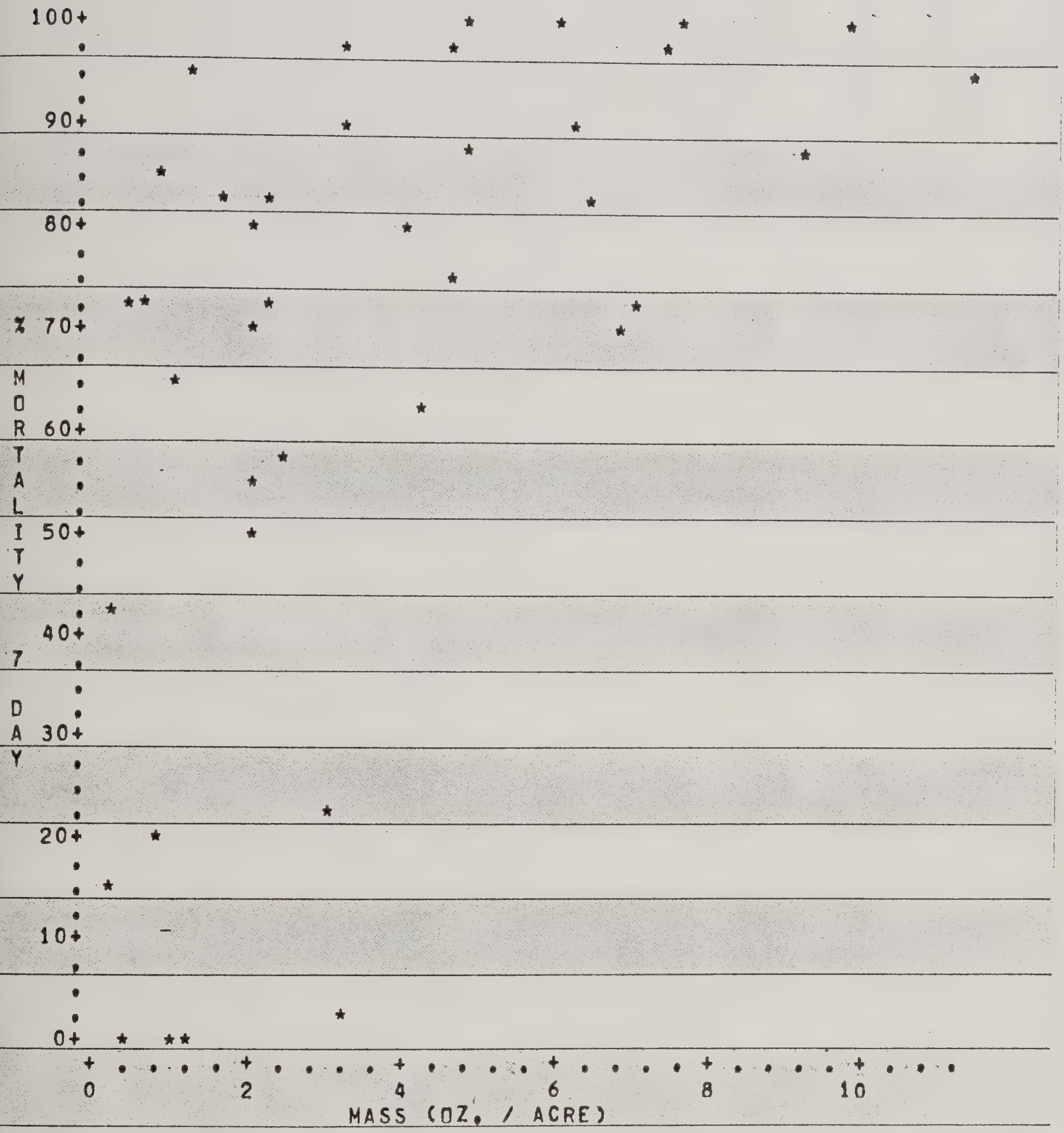


Figure . Graph of 30 oz/A, mortality data, 7 day level as a function of spray deposit in ounces per acre.

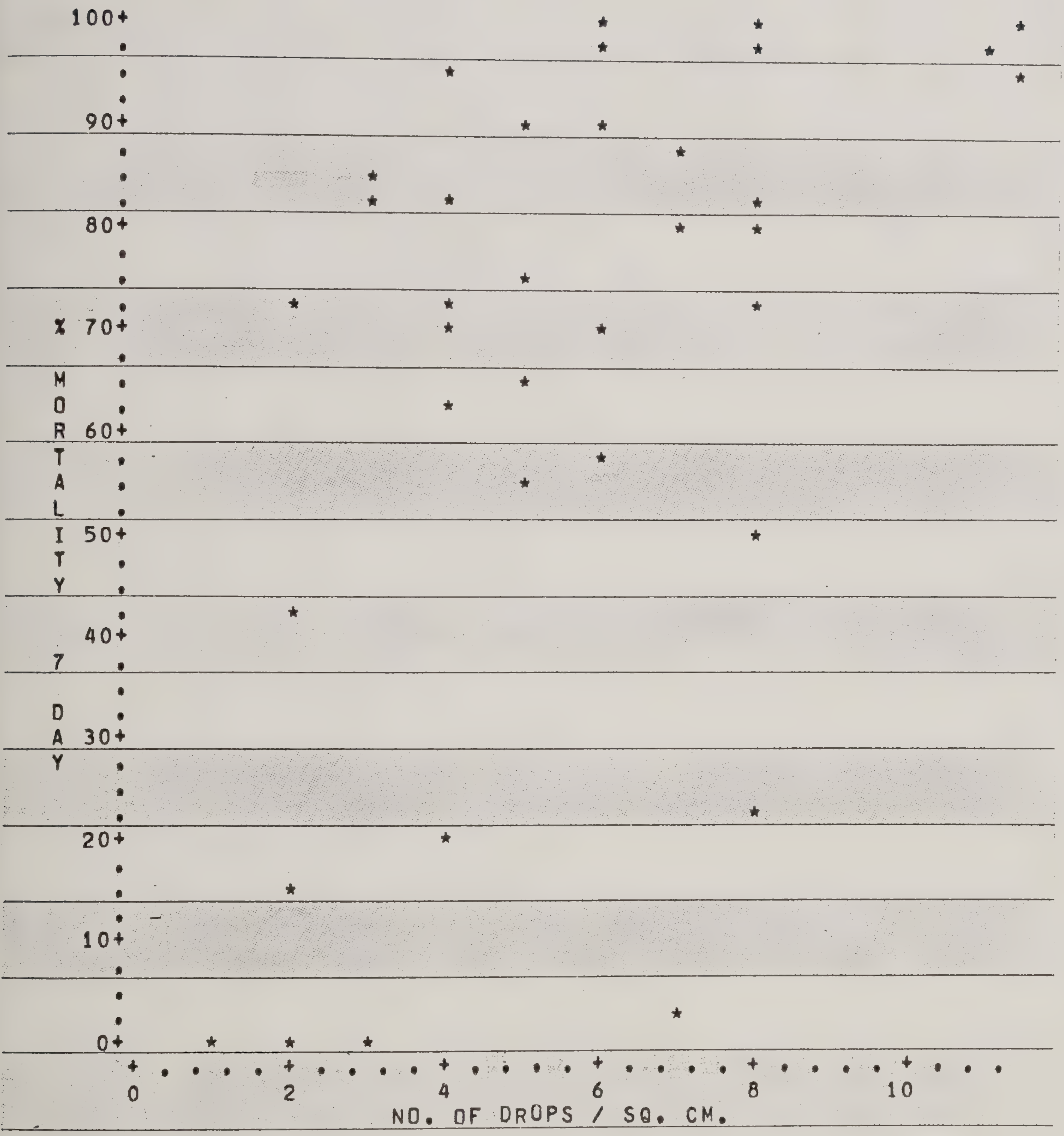


Figure . Graph of 30 oz/A, mortality data, 7 day level as a function of spray deposit in number of drops per cm^2.

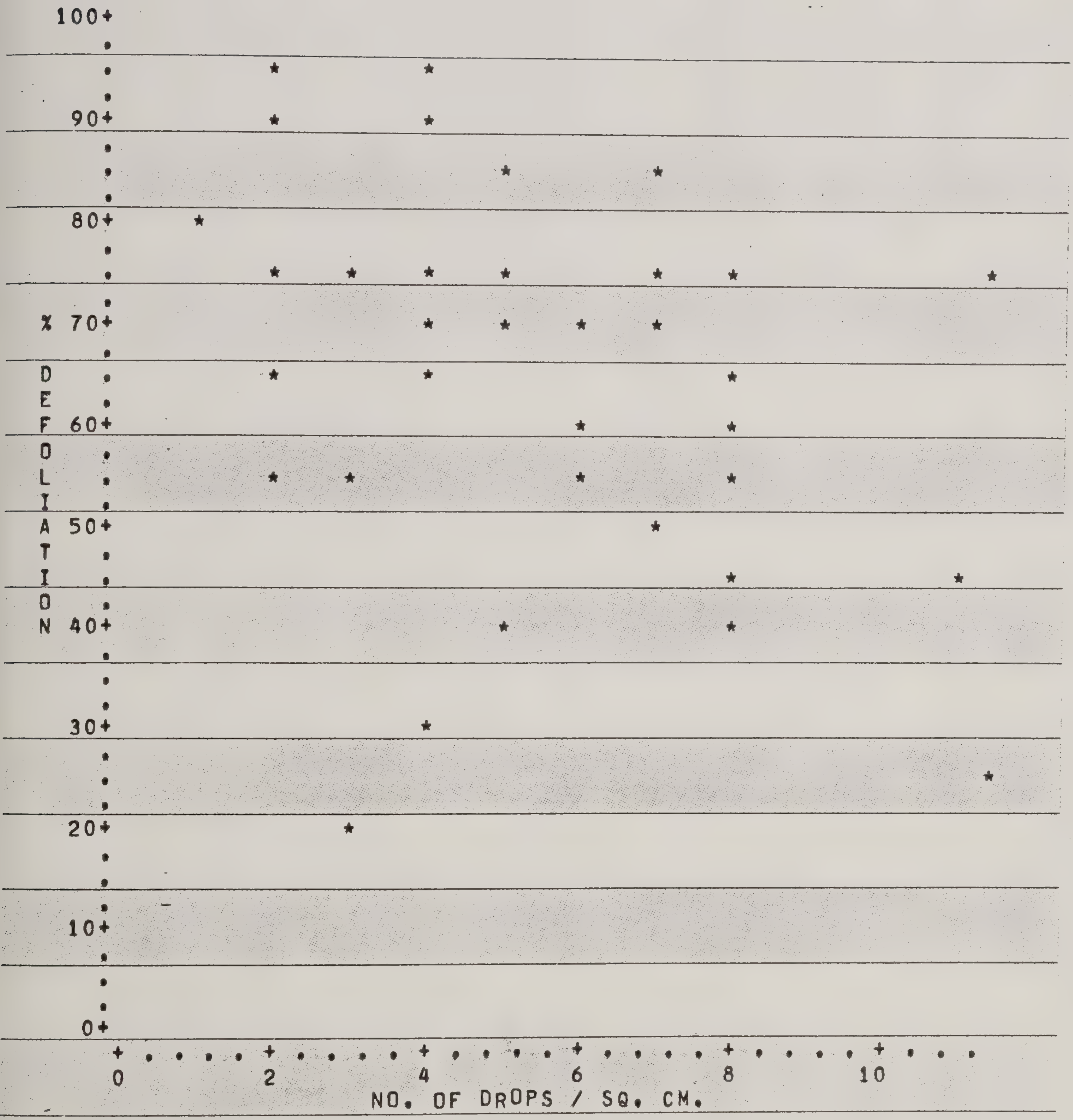


Figure . Graph of 30 oz/A, defoliation data as a function of spray deposit in number of drops per cm^2.

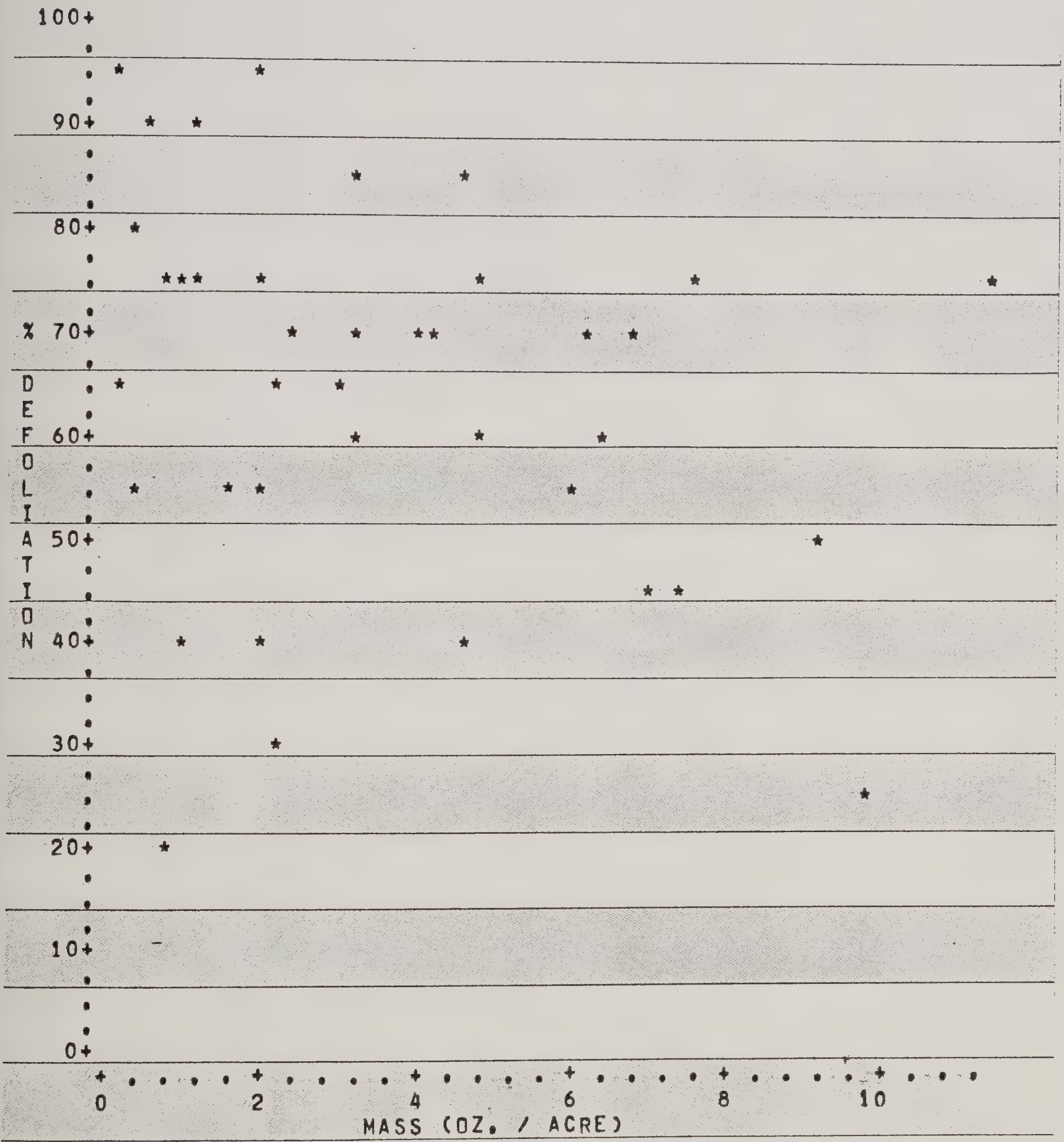


Figure . Graph of 30 oz/A, defoliation data as a function of spray deposit in ounces per acre.

40 oz/A Blocks

Mortality and Defoliation Graphs as a Function of Spray Deposition

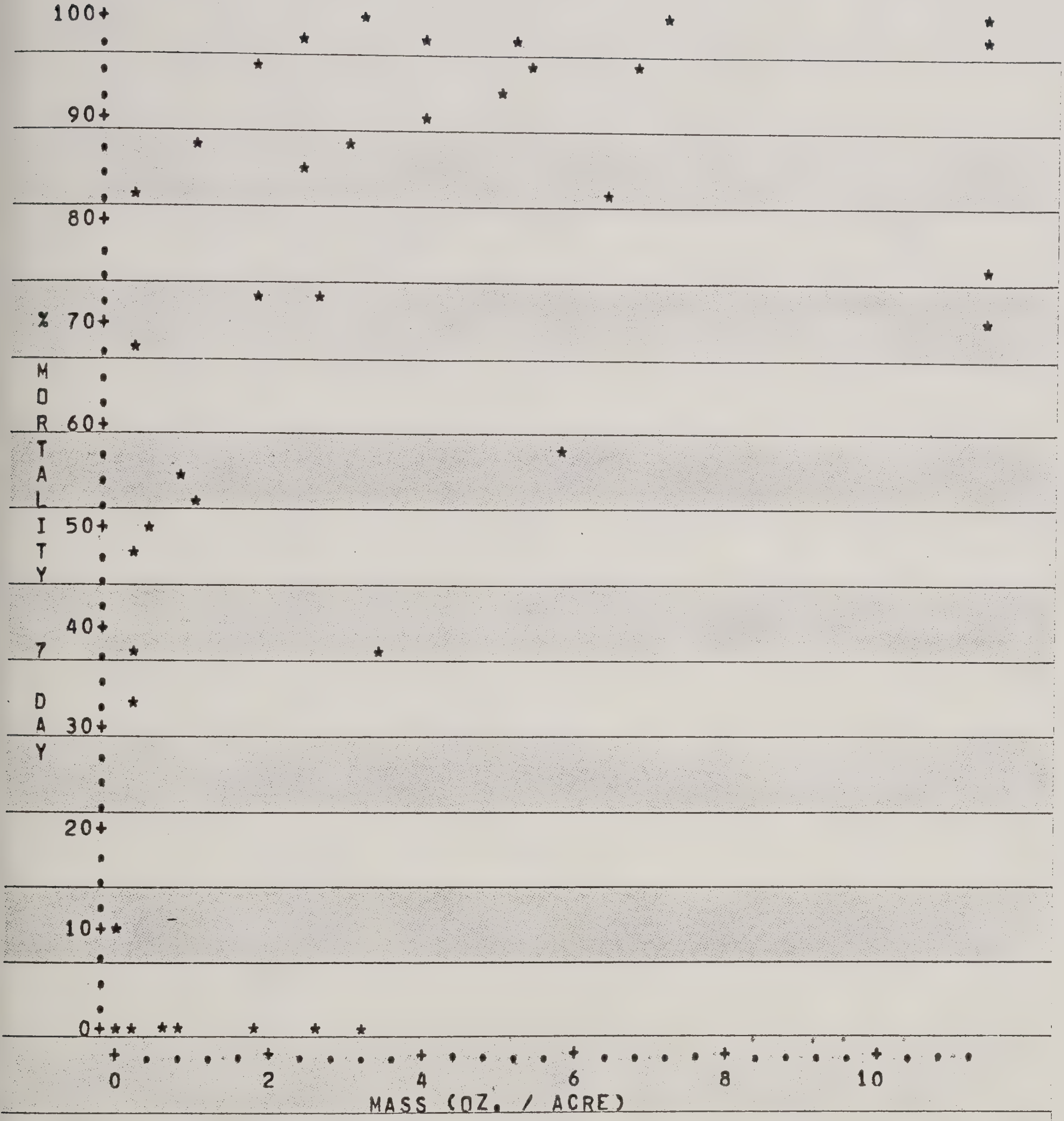


Figure . Graph of 40 oz/A, mortality data, 7 day level as a function of spray deposit in ounces per acre.

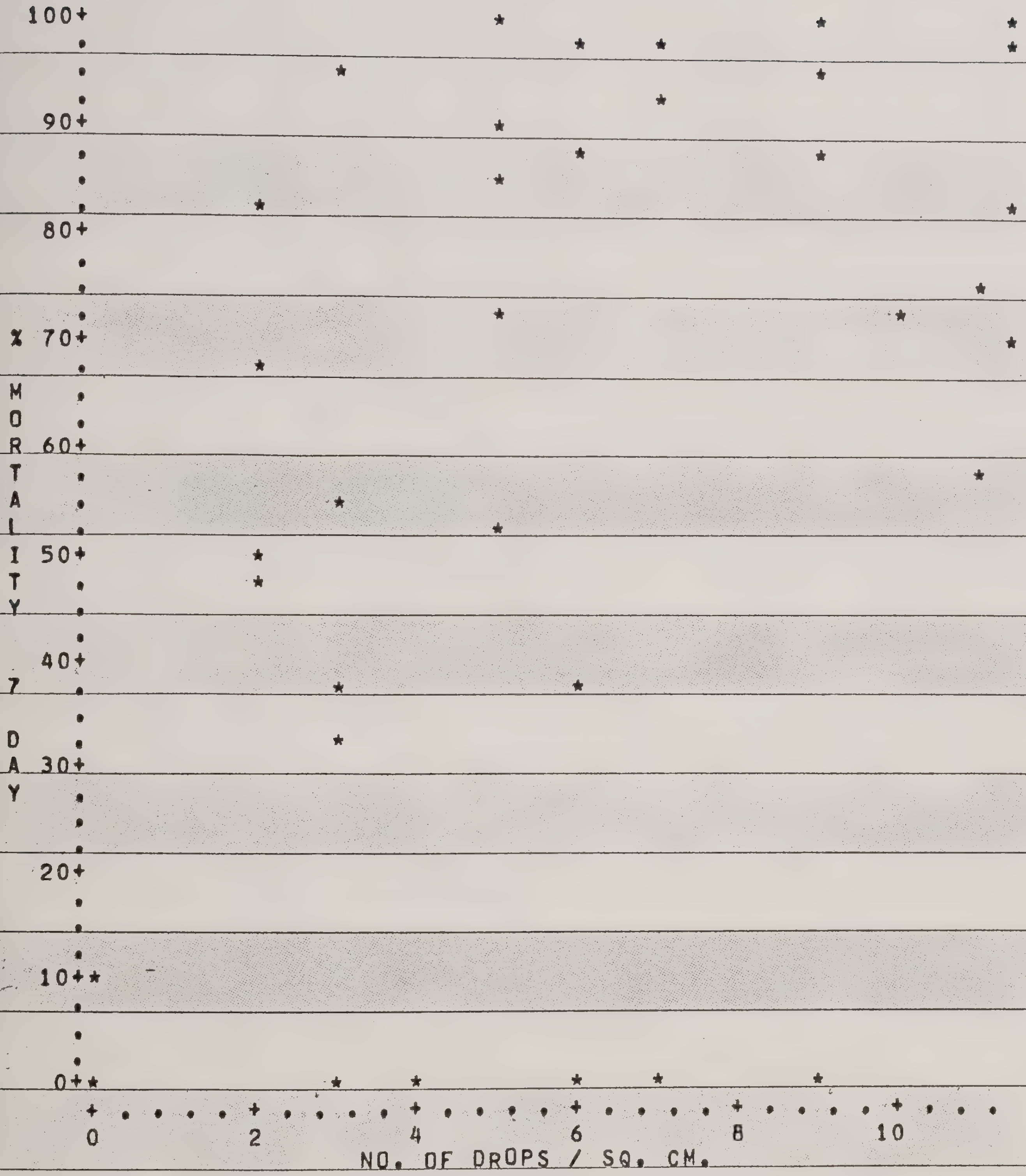


Figure . Graph of 40 oz/A, mortality data, 7 day level as a function of spray deposit in number of drops per cm^2.

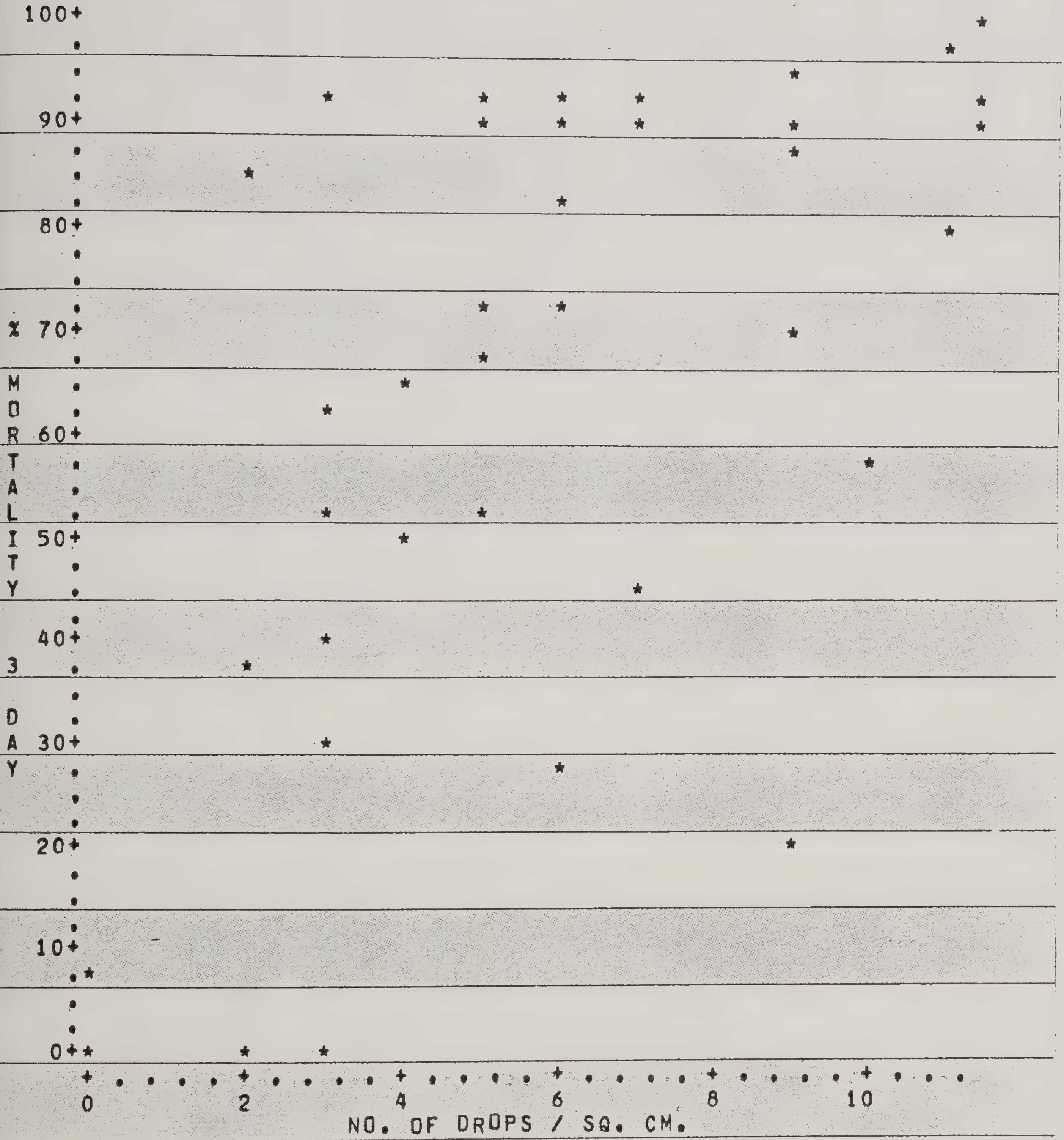


Figure . Graph of 40 oz per acre, mortality data, 3 day level as a function of spray deposit in number of drops per cm^2.

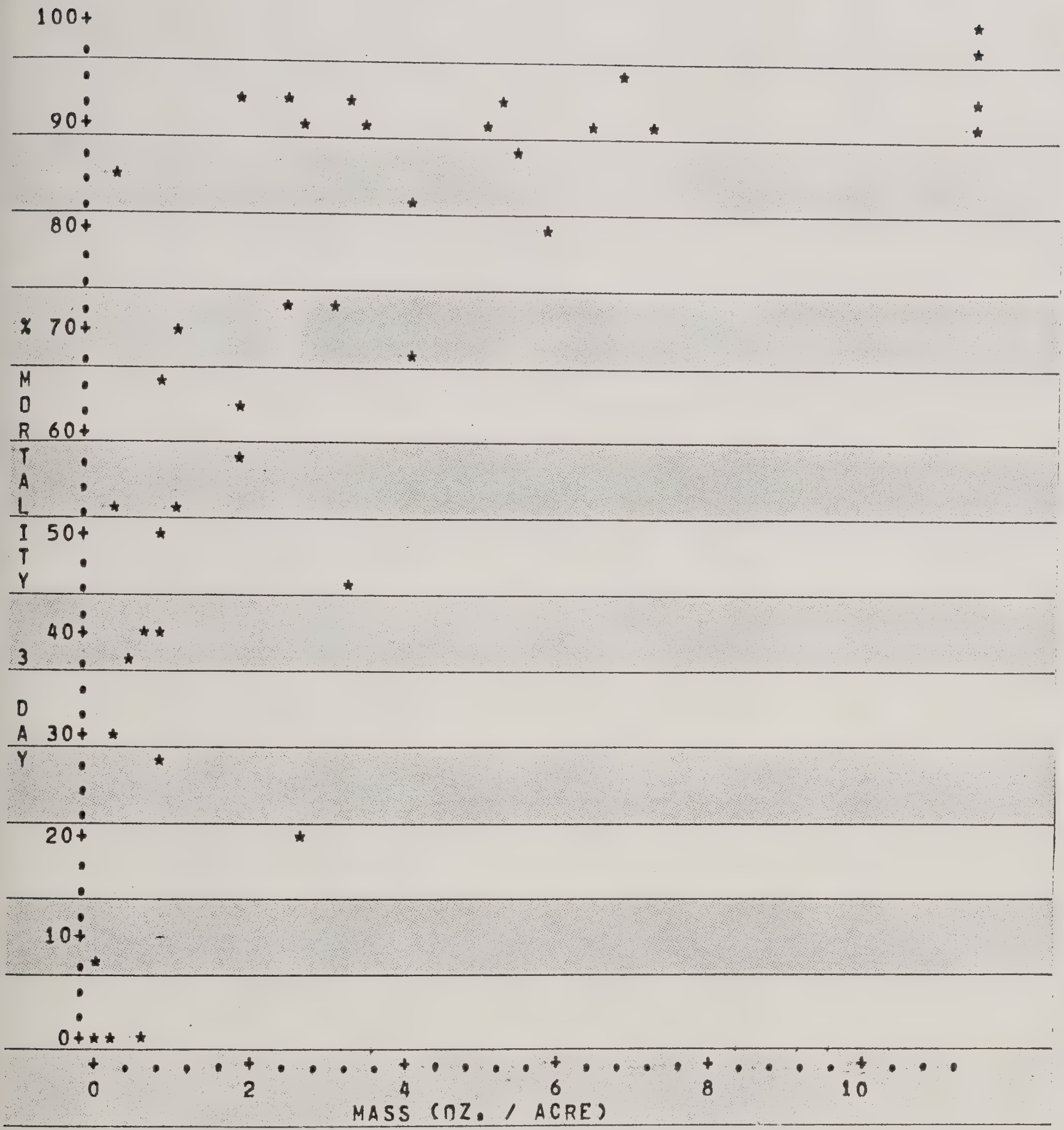


Figure . Graph of 40 oz/A, mortality data, 3 day level as a function of spray deposit in ounces per acre.

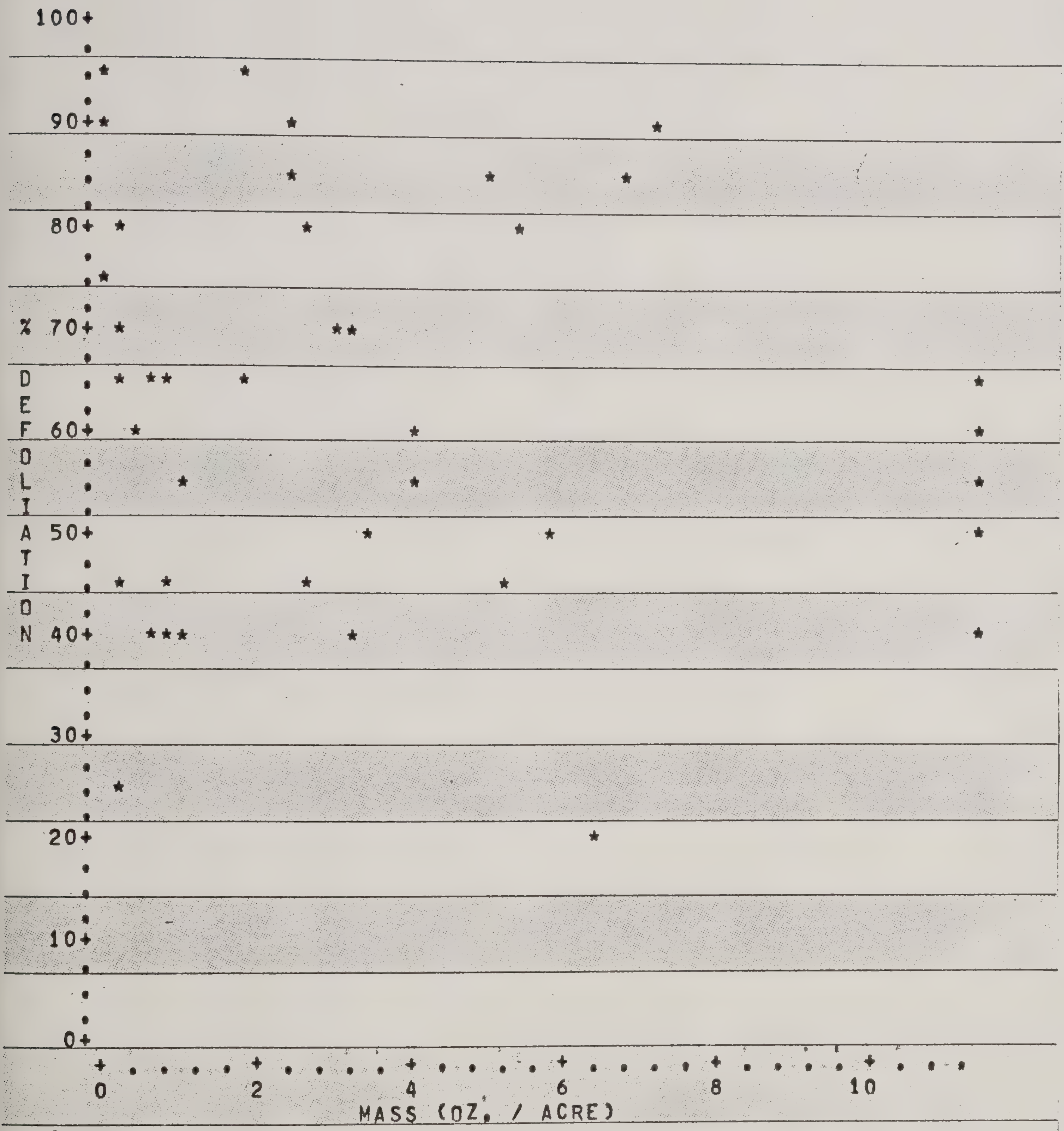


Figure . Graph of 40 oz/A, defoliation data as a function of spray deposit in ounces per acre.

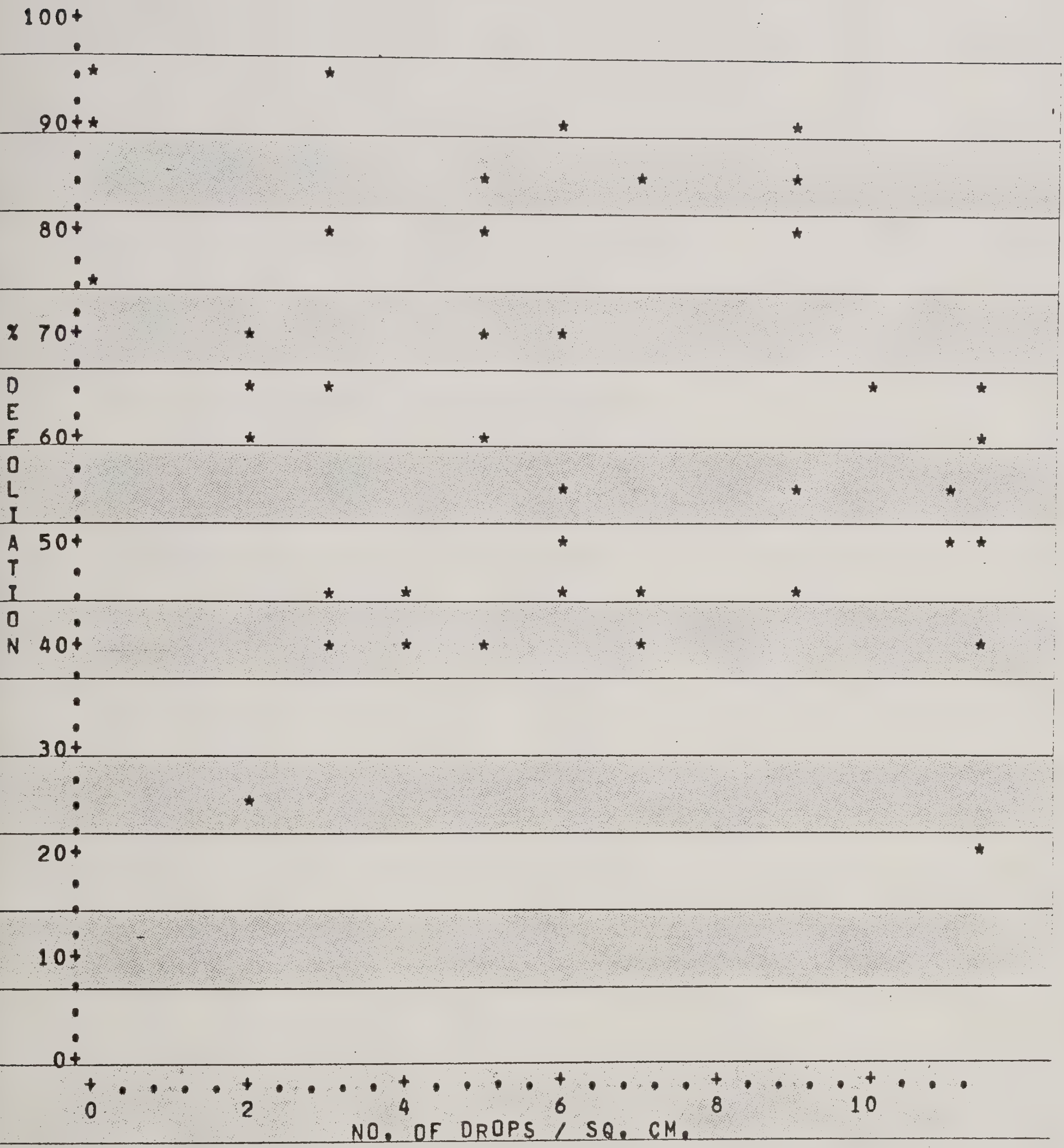
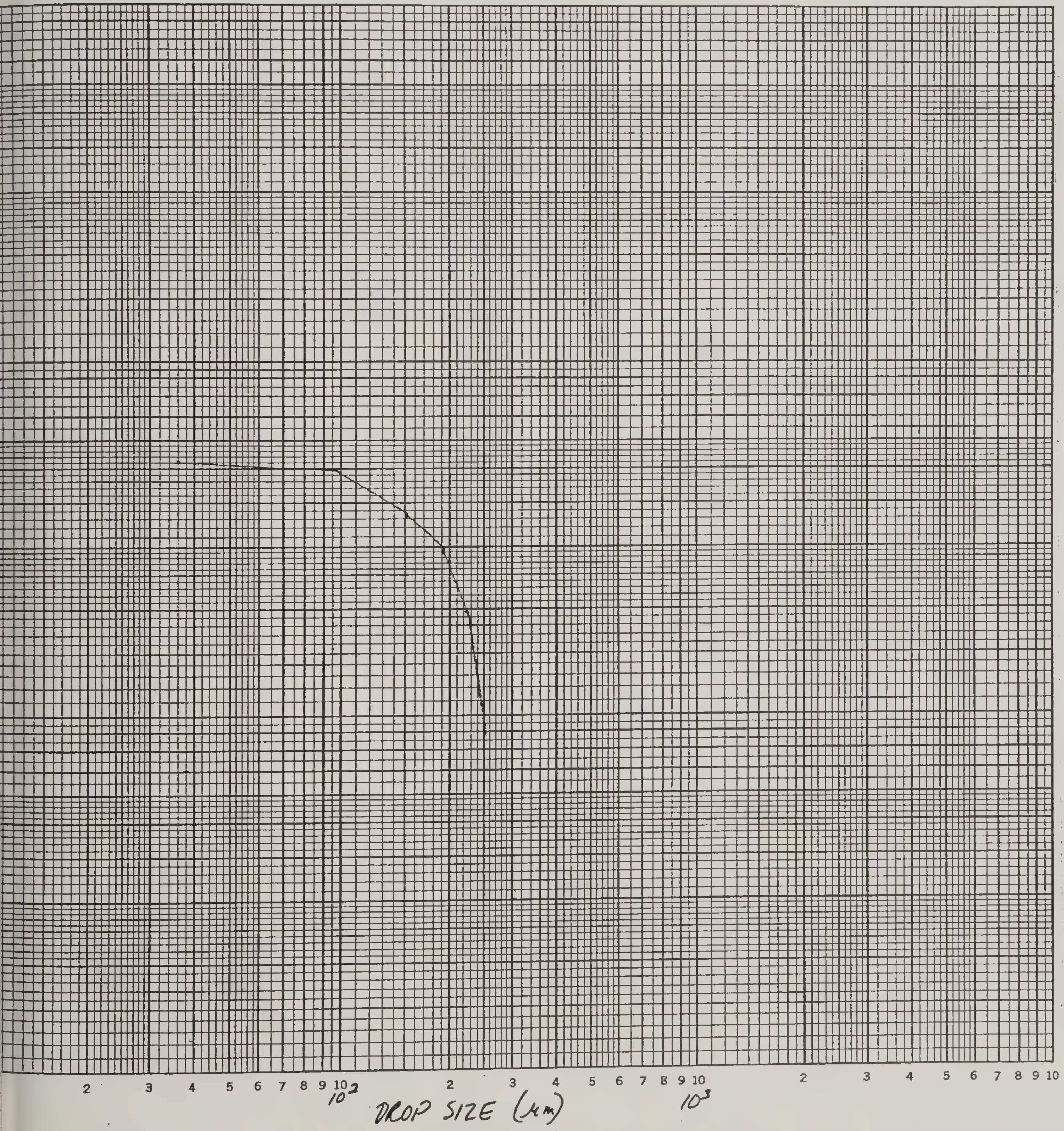
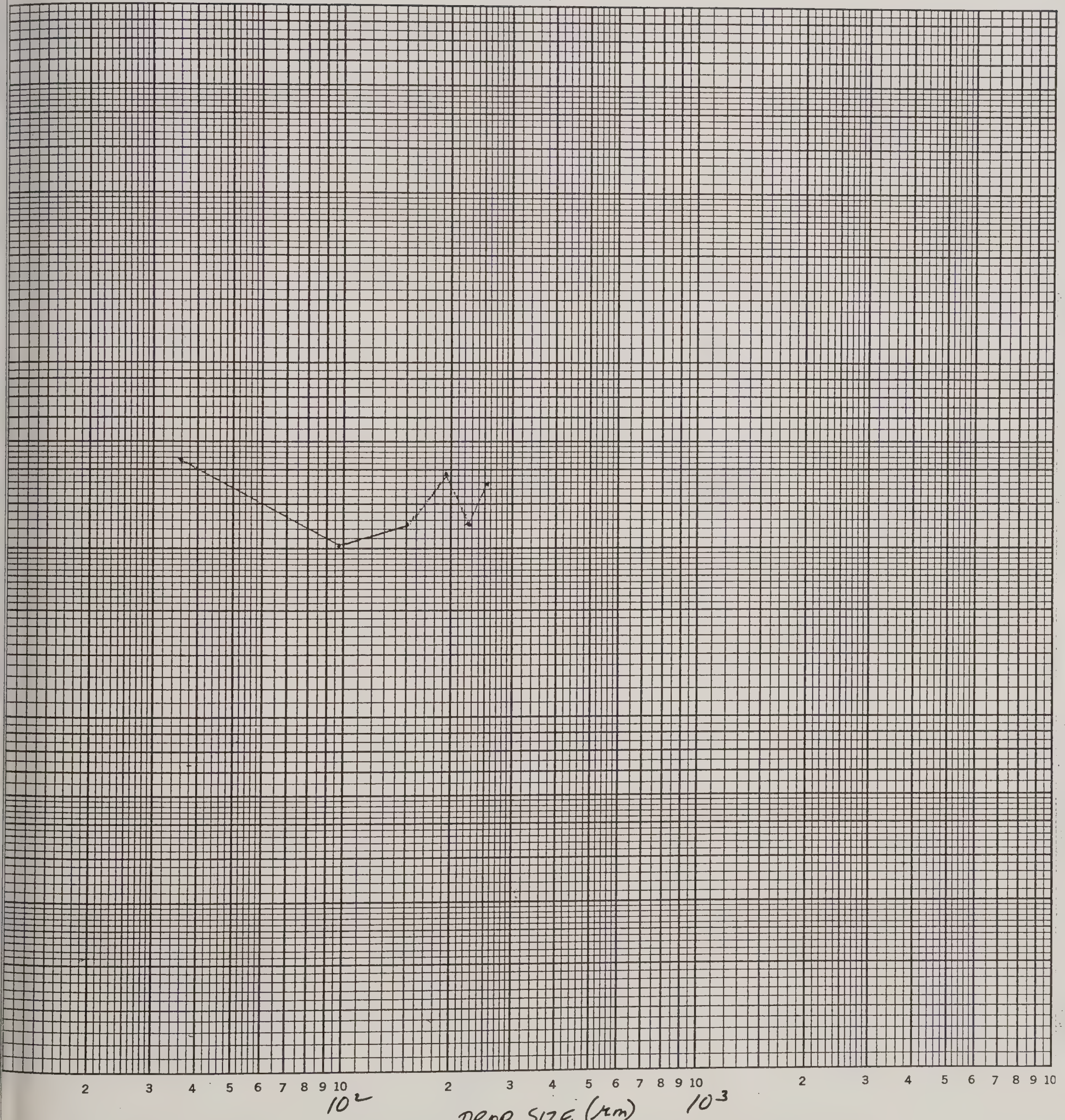


Figure . Graph of 40 oz/A, defoliation data as a function of spray deposit in number of drops per cm^2.

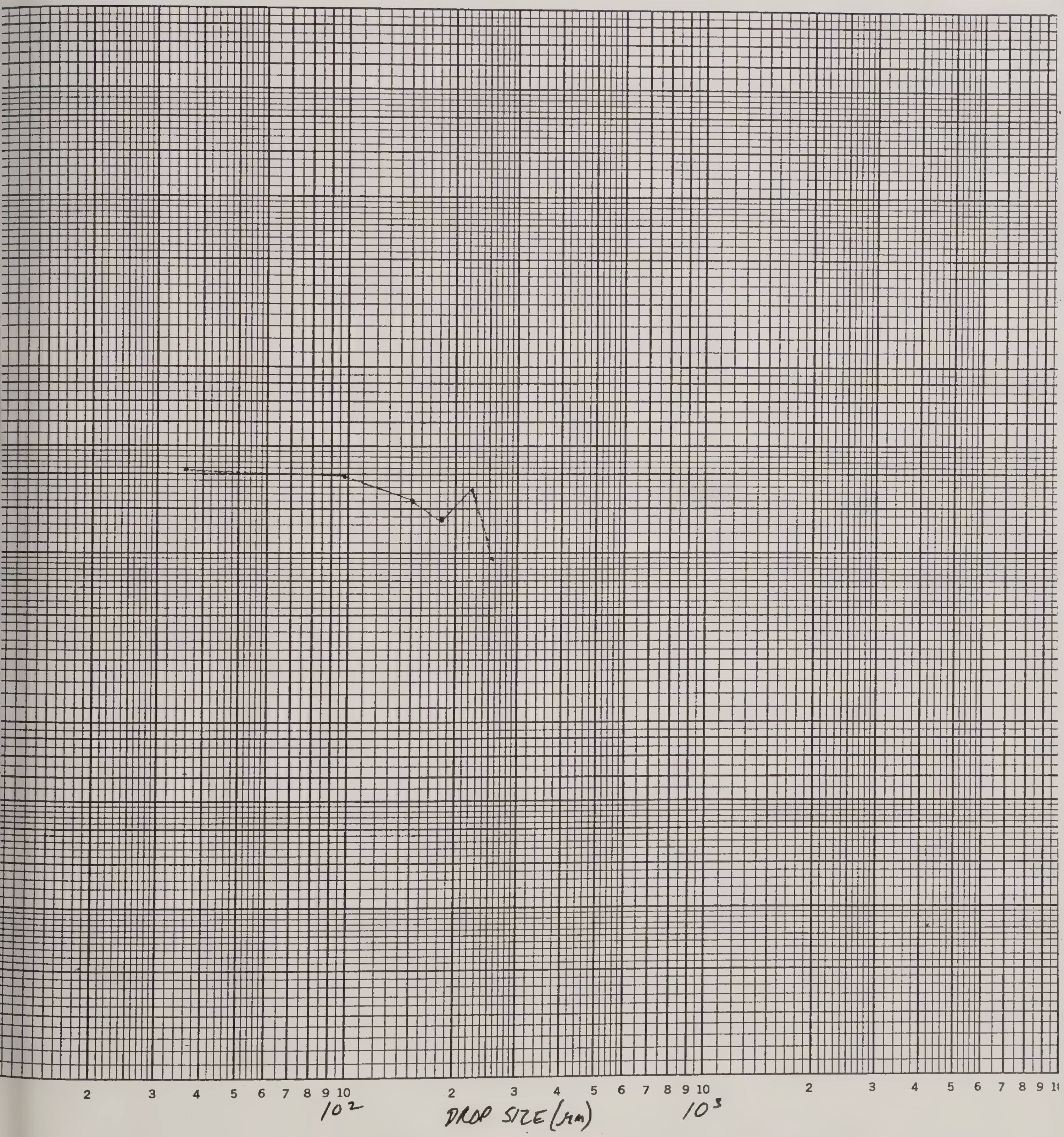
Canopy Penetration Graphs



BLOCK 1 CANOPY PENETRATION MAINE OPERATIONAL PROJECT
PENETRATION RATIO = DROPS UNDER TREES/DROPS IN OPEN
AS A FUNCTION OF DROP SIZE



BLOCK 2 CANOPY PENETRATION MAINE OPERATIONAL PROJECT
PENETRATION RATIO = DROPS UNDER TREES/DROPS IN OPEN
AS A FUNCTION OF DROP SIZE



BLOCK 3 CANOPY PENETRATION MAINE OPERATIONAL PROJECT
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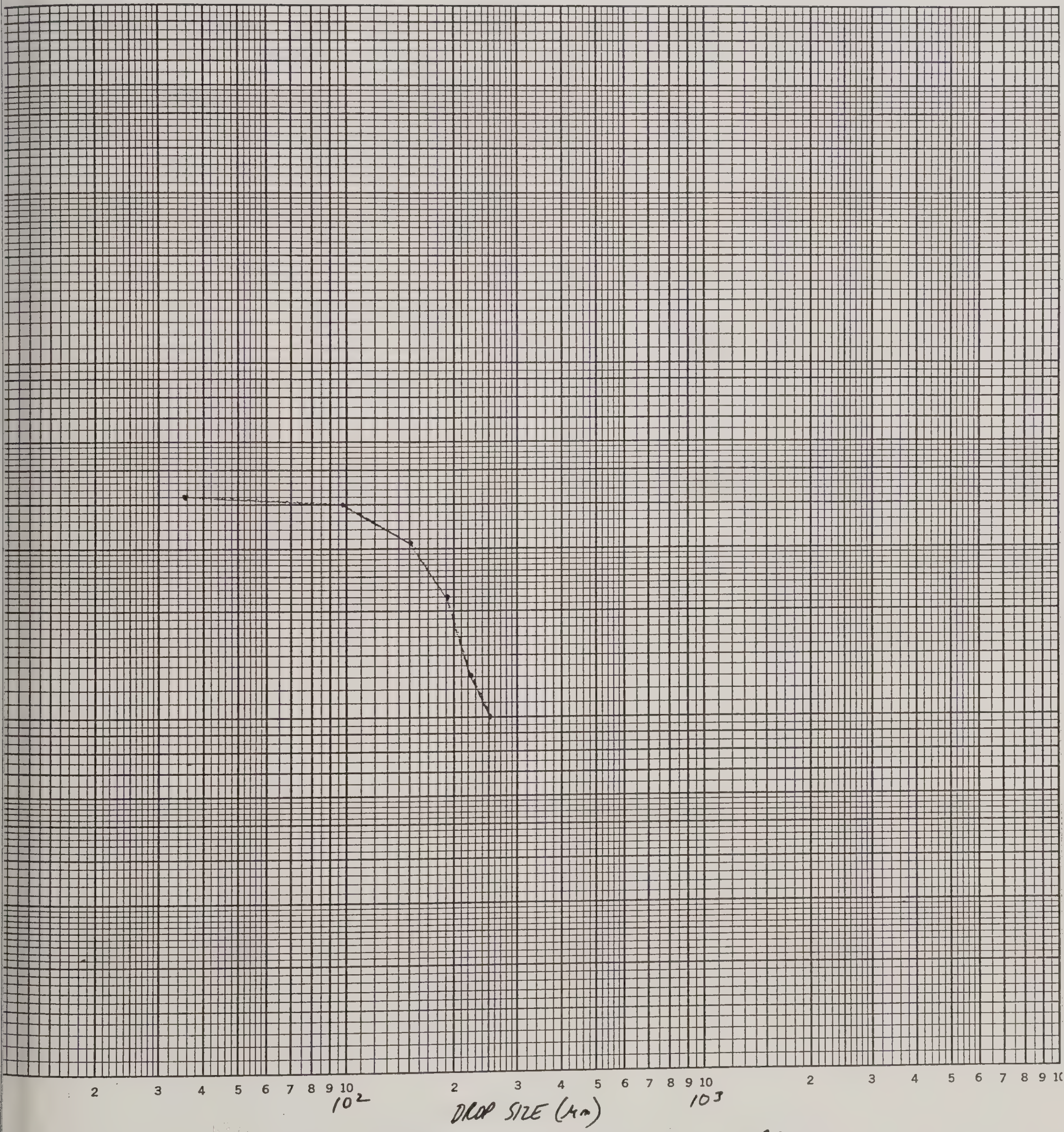
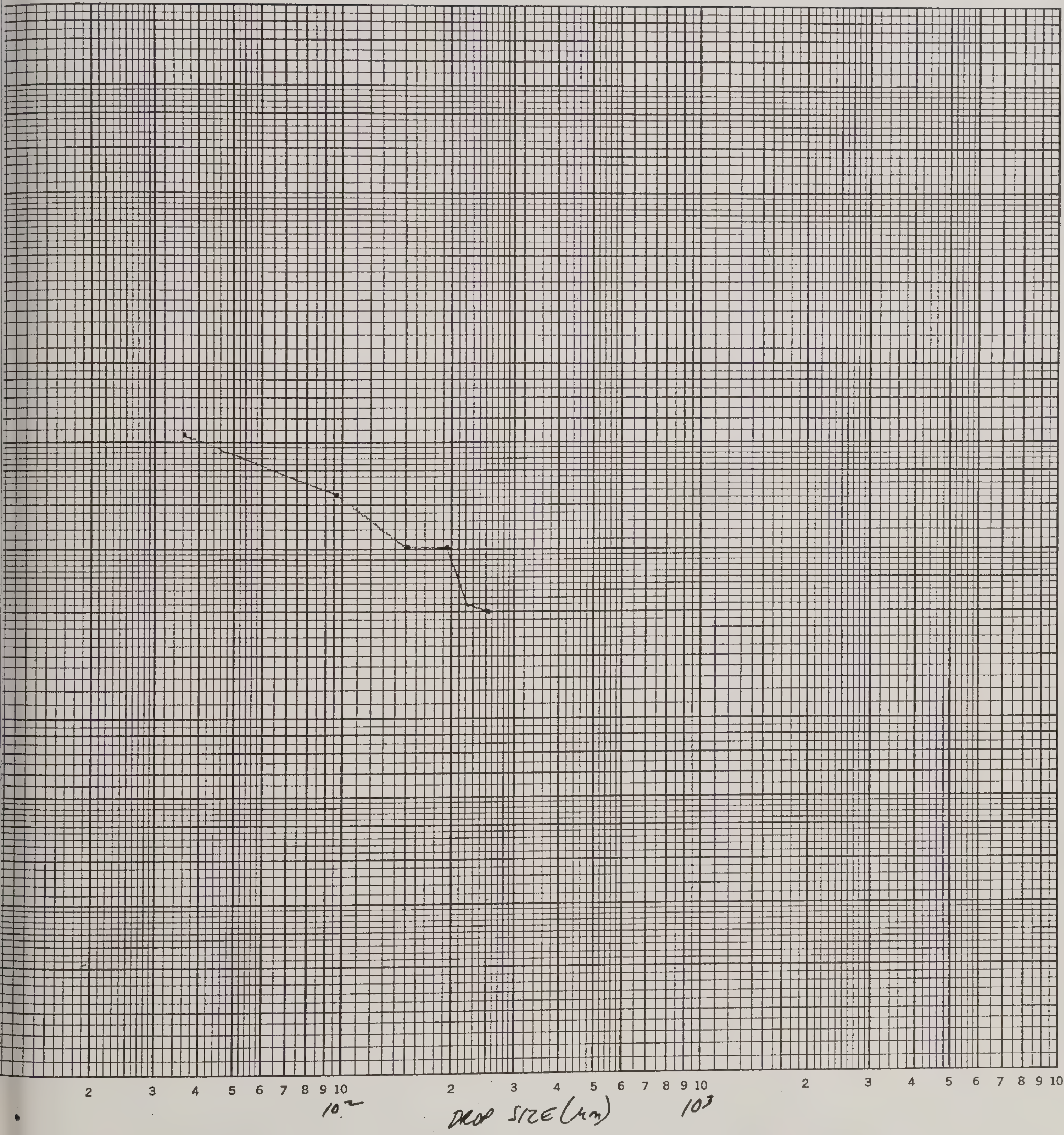
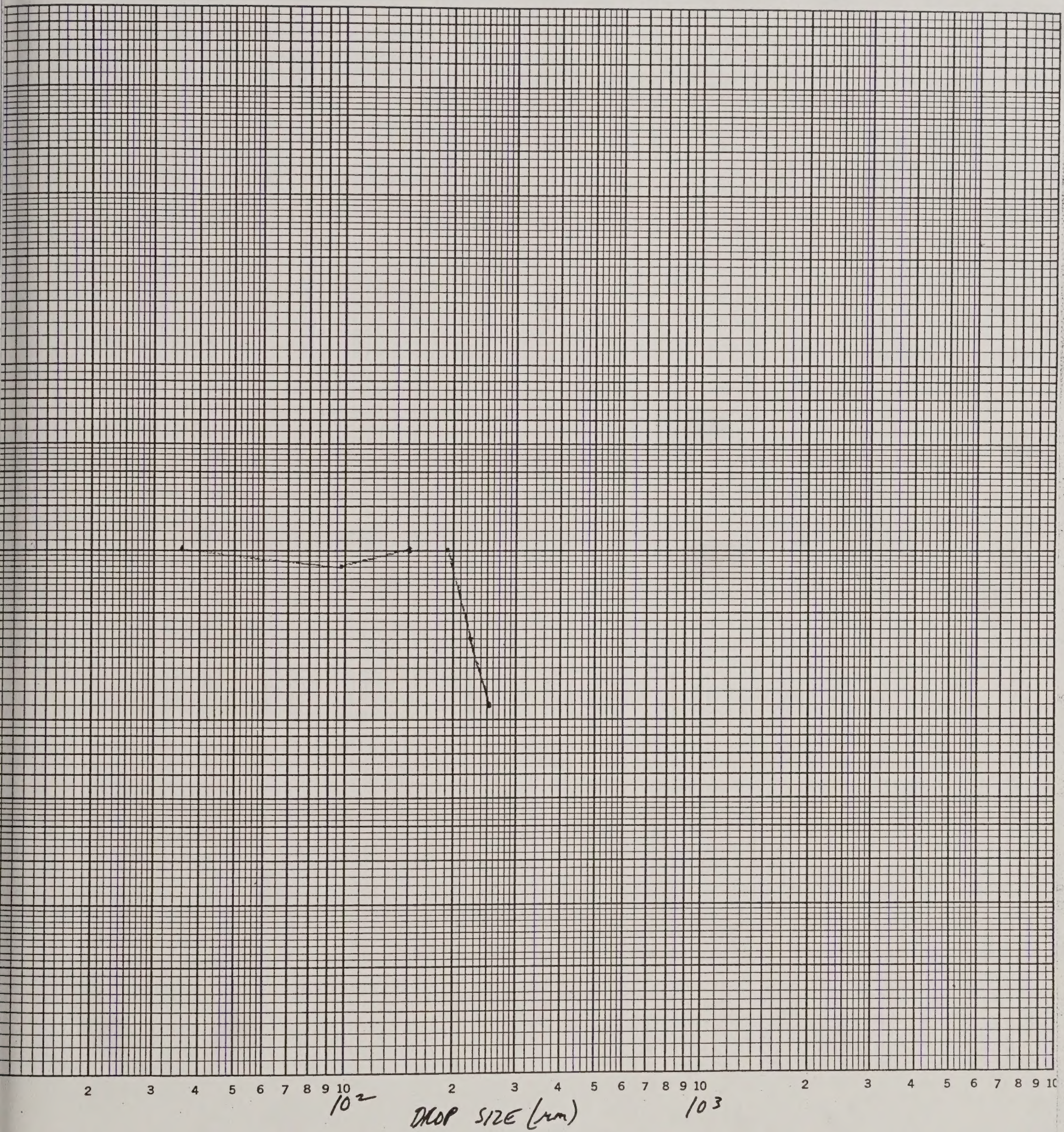
AS A FUNCTION OF DROP SIZE



BLOCK 6 CANOPY PENETRATION MAINE OPERATIONAL PROJECT
PENETRATION RATIO = DROPS UNDER TREES/DROPS IN OPEN
AS A FUNCTION OF DROP SIZE



BLOCK 7 CANOPY PENETRATION MAINE OPERATIONAL PROJECT
PENETRATION RATIO = DROPS UNDER TREES / DROPS IN OPEN
AS A FUNCTION OF DROP SIZE



BLOCK 8 CANOPY PENETRATION MAINE OPERATIONAL PROJECT
PENETRATION RATIO = DROPS UNDER TREES/DROPS IN OPEN
AS A FUNCTION OF DROP SIZE